METHOD FOR ORIENTING AN ACETABULAR CUP AND INSTRUMENTS FOR USE THEREWITH

CROSS-REFERENCE TO RELATED APPLICATION

The present application is a divisional of U.S. patent application Ser. No. 13/587,664, filed Aug. 16, 2012, which claims priority to U.S. patent application Ser. No. 61/524,659, filed Aug. 17, 2011, each of which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

The present invention relates generally to medical orientation and positioning devices and in particular to methods and tools for use in orientating surgical instruments, implements, implants, prosthetics and more specifically, to methods and instruments for orienting an acetabular component (cup) of a total hip replacement using a patient-specific guide that is formed in accordance with the present invention and is configured to guide the acetabular component into the acetabulum.

BACKGROUND

Correct positioning of surgical instruments and implants, used in a surgical procedure, with respect to the patient's anatomy is often a critical factor in achieving a successful outcome. In certain orthopaedic implant procedures, such as total hip replacement (THR), total knee arthroplasty (TKA) and total shoulder replacement (TSR), the optimal orientation of the surgical implant enhances the initial function and the long term operability of the implant.

With respect to THR, proper implantation of the acetabular component (cup) in total hip replacement (THR) is challenging. The hip is a ball and socket joint. In a normal hip, the femoral head is generally circular and rotates within the acetabulum which is also generally circular in shape. Ideally, the load transfer of body weight across the hip joint is distributed across the surface area of the femoral head and acetabulum. By distributing the loads across a maximum surface area of the femoral head and acetabulum, lower stresses result in the joint itself.

In a diseased hip, the ball and socket may be malformed and this can result in an uneven distribution of load. In the event of a deformed femoral head, load is transferred from the femoral head to the acetabulum along the periphery of the femoral head to the periphery of the acetabulum. As will be appreciated, this results in a transfer of load (imported by the body weight and muscle forces) to a surface area of much reduced size causing a high load per unit area value. This increased load per unit area causes damage to the joint by damaging the articular cartilage which over time can wear out.

From a biomechanical standpoint, successful hip function depends on a number of factors including the alignment of an acetabular cup. Accurate orienting of the cup is an important variable in reducing the risk of dislocation, bearing impingement, wear and edge loading, revisions, and long-term survivorship of the THR. Proper cup orientation can be determined by considering the appropriate abduction angle and anteversion of the component.

Various techniques involving bony landmarks or intra-operative jigs have been developed to allow the operating surgeon to produce accurate and reproducible cup placements.

Alignment tools (guides) typically references the surgical table on which the patient rests. Conventionally, it is assumed that the patient's pelvis is parallel to the table, and the surgical table is parallel to the floor. Based on the proceeding assumptions, the ordinary orientation for most patients for the acetabular cup is between 40° and 45° of inclination and around 20° anteversion.

However, these techniques are subject to inaccuracies due to the variability of the patient's pelvic position on the operating table, degenerative lumbosacral disease, pelvic tilt, and the presence of osteophytes which makes bony landmarks harder to identify. For this reason, newer instruments utilizing computer assisted navigation or haptic robots have become more popular. However, these instruments are very expensive, require additional components (pins and rays) and have a long learning curve and thus are not entirely desirable for these reasons. In addition, as described below, a number of patient-specific guides have been developed by using the rim of the acetabulum to fit the patient-specific guide; however, the rim of the acetabulum is difficult to access as a result of it being covered in part by soft tissue and consequently, these guides suffer from this deficiency and others.

There is thus a need to overcome these deficiencies and provide an improved method(s) and instrument(s) for orienting the acetabular component (cup) during and as part of a total hip replacement procedure.

SUMMARY

In one embodiment of the present invention, a patient-specific acetabular guide for use in orienting an acetabular component with respect to an acetabulum of a patient as part of a surgical procedure is provided. The patient-specific guide includes a body having a bottom contact surface that has a portion that is shaped and configured to initimately receive and interlockingly mate with an acetabular notch of the patient's acetabulum in accordance with a three-dimensional image of the acetabulum of the specific patient. The three-dimensional image can be in the form of a three-dimensional virtual model of the patient's acetabulum that is constructed at least in part on 3D image data of the pelvic region of the patient.

In accordance with one embodiment, a method of pre-operatively planning the implantation of a patient-specific acetabular component comprising the steps of: (1) obtaining three-dimensional image data of a pelvic region of the patient; (2) using the obtained image data to determine a selected orientation of the acetabular component with respect to an acetabulum of the patient, the selected orientation being defined by a center longitudinal axis; and (3) constructing a three-dimensional model of an acetabular guide from the obtained image data, wherein the three-dimensional model of the acetabular guide includes a contact surface that is shaped to substantially match an acetabular notch of the patient's acetabulum, wherein a center longitudinal axis of the acetabular guide is co-linear or parallel to the center axis of the acetabular component.

In accordance with one embodiment, a method for implanting an acetabular component in an acetabulum of a patient comprising the steps of: (1) inspecting a pre-operative plan including a three-dimensional image of the specific patient; (2) selecting a patient-specific anteversion angle and an inclination angle for the acetabular component so as to define a prescribed orientation for the acetabular component; (3) constructing a patient-specific acetabular guide having a contact surface that is made to conform to an acetabular notch of the acetabular of the patient in accordance with the three-dimen-